E/ECE/324
E/ECE/TRANS/505 } Rev.1/Add.87
31 March 1993

AGREEMENT

CONCERNING THE ADOPTION OF UNIFORM CONDITIONS OF APPROVAL AND RECIPROCAL RECOGNITION OF APPROVAL FOR MOTOR VEHICLE EQUIPMENT AND PARTS

done at Geneva on 20 March 1958

Addendum 87: Regulation No. 88

Date of entry into force: 10 April 1991

UNIFORM PROVISIONS CONCERNING THE APPROVAL OF RETROREFLECTIVE TYPES FOR TWO-WHEELED VEHICLES

UNITED NATIONS

Regulation No. 88

UNIFORM PROVISIONS CONCERNING THE APPROVAL OF RETROREFLECTIVE TYRES FOR TWO-WHEELED VEHICLES

CONTENTS

REGULATION		Page
1.	Scope	5
2.	Definitions	5
3.	Applications for approval	7
4.	Markings	8
5.	Approval	8
6.	Modifications of the retroreflective tyre type and extension of approval	9
7.	Conformity of production	10
8.	Penalties for non-conformity of production	10
9.	Production definitely discontinued	10
10.	General specifications	10
11.	Special specifications (tests)	11
12.	Names and addresses of technical services responsible for conducting approval tests, and of administrative departments	11

CONTENTS (continued)

Page

ANNEXES

Annex 1 - The CIE Coordinate system 12

Annex 2 - Communication concerning the approval or refusal or extension or withdrawal of approval or production definitely discontinued of a type of retroreflective tyre, pursuant to Regulation No. 88 13

Annex 3 - Example of the arrangement of the approval mark 15

Annex 4 - Test procedures 16

Annex 5 - Colorimetric specifications 17

Annex 6 - Photometric specifications 18

Annex 7 - Resistance to external agents 20

Annex 8 - Resistance to heat 22

Regulation No. 88

UNIFORM PROVISIONS CONCERNING THE APPROVAL OF RETROREFLECTIVE TYRES FOR TWO-WHEELED VEHICLES

1. SCOPE

These provisions apply to fixed retroreflecting devices incorporated in the tyre sidewalls for use on mopeds and bicycles to provide a visual impression of circles of light; thus giving easy recognition of a two-wheeled vehicle.

2. DEFINITIONS 1/

2.1 General Definitions

2.1.1 Retroreflection

Reflection in which radiation is returned to directions close to the direction from which it came, this property being maintained over wide variations of the direction of the incident radiation.

2.1.2 Retroreflector

A surface or device from which, when directionally irradiated, a relatively large portion of the reflected radiation is retroreflected.

2.1.3 Retroreflecting Tyre

Means a tyre ready for use and comprising retroreflecting annuli moulded on to each sidewall of the tyre.

2.2 Geometric Definitions

See figure of annex 1.

2.2.1 Reference Centre

A point at the centre of the wheel on which the tyre is mounted.

1/ The definitions of technical terms are those adopted by the International Commission on Illumination (CIE), see Technical Report CIE Publication 54, Retroreflection Definition and Measurement, 1982.

2.2.2 Illumination Axis

A line segment from the reference centre to the source.

2.2.3 Observation Axis

A line segment from the reference centre to the photometer head.

2.2.4 Observation Angle (Symbol α)

The angle between the illumination axis and the observation axis. The observation angle is always positive and in the context of retroreflection is restricted to small acute angles. Maximum range: $0 \leq \alpha < 180°$.

2.2.5 Observation Half-Plane

The half-plane which originates on the illumination axis and which contains the observation axis.

2.2.6 Reference Axis

The axis of the wheel on which the tyre is mounted.

2.2.7 Entrance Angle (Symbol β)

The angle from the illumination axis to the reference axis. The entrance angle is usually no larger than 90°, but for completeness its full range is defined as $0 \leq \beta \leq 180°$. In order to completely specify the orientation, this angle is characterized by two components β_1 and β_2.

2.2.8 First Axis

An axis through the reference centre and perpendicular to the observation half-plane.

2.2.9 First Component of the Entrance Angle (Symbol β_1)

The angle from the illumination axis to the plane containing the reference axis and the first axis.

Range: $-180° < \beta_1 \leq 180°$.

2.2.10 Second Component of the Entrance Angle (Symbol β_2)

The angle from the plane containing the observation half-plane to the reference axis.

Range: $-90° \leq \beta_2 \leq 90°$.

2.2.11 Second Axis

An axis through the reference centre and perpendicular to both the first axis and the reference axis. The positive direction of the second axis lies in the observation half-plane when $-90 < \beta_1 < 90°$ as shown in figure of annex 1.

2.3 Definition of Principal Photometric Terms

2.3.1 Coefficient of Luminous Intensity

The quotient obtained from dividing the luminous intensity (I) of the retroreflector in the direction of observation by the illuminance ($E_\perp$) at the retroreflector on a plane perpendicular to the direction of the incident light.

Symbol R $$R = \frac{I}{E_\perp}$$

Note: In the photometry of retroreflectors this coefficient is expressed in millicandelas per lux ($mcd.lx^{-1}$).

2.3.2 Angular Diameter of the Retroreflecting Device (Symbol $\mathcal{H}$)

Means the angle subtended by the greatest dimension of the visible area of the retroreflective annulus, either at the centre of the source of illumination or at the centre of the receiver.

2.4 Definition of a Type of Retroreflecting Device

2.4.1 Retroreflecting devices of different "types" means devices which differ in such essential respects as:

2.4.2 The trade name or mark;

2.4.3 The parts affecting the properties of the retroreflecting device to which the Regulation applies.

3. APPLICATION FOR APPROVAL

3.1 The application for approval shall be submitted by the holder of the trade name or mark, or if necessary by his duly accredited representative, and shall be accompanied by:

3.1.1 Drawings, in triplicate, in sufficient detail to permit identification of the type. The drawings must show the position intended for the approval number and the identification symbol in relation to the circle of the approval mark; the dimensions of the retroreflective film and of the tyre as well as the recommended maximum tyre pressure must be indicated.

3.1.2 A brief description giving the technical specification of the material of which the retroreflecting annulus is made and of the tyre material;

3.1.3 Samples of the retroreflective tyre, the number of samples to be submitted is specified in annex 4.

4. MARKINGS

4.1 Every retroreflecting tyre submitted for approval must bear:

4.1.1 The trade name or mark of the applicant;

4.1.2 The recommended maximum tyre pressure in bar.

4.2 A space of sufficient size to accommodate the approval mark shall be provided on every tyre. This space shall be shown on the drawings referred to in paragraph 3.1.1 above.

4.3 The markings must be clearly legible and be indelible and well visible, even when the tyre is mounted on the rim.

5. APPROVAL

5.1 If all the samples submitted meet the requirements of this Regulation, approval shall be granted.

5.2 An approval number shall be assigned to each tyre approved. Its first two digits (at present 00 for the Regulation in its original form) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party shall not assign the same number to another type of retroreflecting tyre as defined in paragraph 2.4 above.

5.3 Notice of approval or of refusal or extension or withdrawal of approval or production definitely discontinued of a retroreflective tyre type pursuant to this Regulation shall be communicated to the Parties to the Agreement applying this Regulation, by means of a form conforming to the model in annex 2 to this Regulation.

5.4 There shall be affixed to every retroreflecting tyre conforming to a type approved under this Regulation, in the space referred to in paragraph 4.2 above and in addition to the markings prescribed in paragraphs 4.1.1 and 4.1.2:

5.4.1 An international approval mark consisting of:

5.4.1.1 A circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval; 2/

5.4.1.2 The number of this Regulation, followed by the letter "R", a dash and the approval number;

5.5 Annex 3 to this Regulation gives an example of the arrangement of the approval mark.

6. MODIFICATIONS OF THE RETROREFLECTIVE TYRE TYPE AND EXTENSION OF APPROVAL

6.1 Every modification of the retroreflective tyre type shall be notified to the administrative department which approved the retroreflective tyre type. The department may then either:

6.1.1 Consider that the modifications made are unlikely to have an appreciable adverse effect and that in any case the retroreflective tyre still complies with the requirements; or

6.1.2 Require a further test report from the technical service responsible for conducting the tests.

6.2 Confirmation or refusal of approval, specifying the alterations, shall be communicated by the procedure specified in paragraph 5.3 above to the Parties to the Agreement which apply this Regulation.

6.3 The competent authority issuing the extension of approval shall assign a series number to each communication form drawn up for such an extension and inform thereof the other parties to the 1958 Agreement applying this Regulation by means of a communication form conforming to the model in annex 2 to this Regulation.

2/ 1 for Germany, 2 for France, 3 for Italy, 4 for the Netherlands, 5 for Sweden, 6 for Belgium, 7 for Hungary, 8 for Czech and Slovak Federal Republic, 9 for Spain, 10 for Yugoslavia, 11 for the United Kingdom, 12 for Austria, 13 for Luxembourg, 14 for Switzerland, 15 vacant, 16 for Norway, 17 for Finland, 18 for Denmark, 19 for Romania, 20 for Poland, 21 for Portugal, 22 for the Russian Federation and 23 for Greece. Subsequent numbers shall be assigned to other countries in the chronological order in which they ratify or accede to the Agreement concerning the Adoption of Uniform Conditions of Approval and Reciprocal Recognition of Approval for Motor Vehicle Equipment and Parts, and the numbers thus assigned shall be communicated by the Secretary-General of the United Nations to the Contracting Parties to the Agreement.

7. CONFORMITY OF PRODUCTION

7.1 Every tyre bearing an approval mark as prescribed in this Regulation shall conform to the type approved.

7.2 Conformity with regard to mechanical and geometrical characteristics shall be considered sufficient if the divergences are not greater than unavoidable manufacturing tolerances.

7.3 The conformity of production shall not be contested if all the photometric measurements of one specimen taken at random are equal to at least 80 per cent of the specification.

7.4 If the requirement in paragraph 7.3 is not met, a further sample consisting of five specimens shall be taken at random. The average of all like photometric measurements shall be at least equal to the specification and no individual measurement may be less than 50 per cent of the specification.

8. PENALTIES FOR NON-CONFORMITY OF PRODUCTION

If a Party to the Agreement applying this Regulation withdraws an approval it has previously granted, it shall forthwith so notify the other Contracting Parties applying this Regulation, by means of a communication form conforming to the model in annex 2 to this Regulation.

9. PRODUCTION DEFINITELY DISCONTINUED

If the holder of the approval completely ceases to manufacture a type of retroreflecting tyre approved in accordance with this Regulation, he shall so inform the authority which granted the approval. Upon receiving the relevant communication that authority shall inform thereof the other Parties to the Agreement applying this Regulation, by means of a communication form conforming to the model in annex 2 to this Regulation.

10. GENERAL SPECIFICATIONS

10.1 Retroreflecting tyres must be so constructed that they function satisfactorily and will continue to do so in normal use. In addition, they must not have any defect in design or manufacture that is detrimental to their efficient operation or to their maintenance in good condition.

10.2 The retroreflective annulus shall be in the form of a continuous circle of retroreflective material moulded into each sidewall of the tyre.

10.3 The retroreflective annulus shall not be replaceable.

10.4 The outer surfaces of each retroreflecting annulus must be easy to clean. Hence it must not be a rough surface; any protuberances it may exhibit must not prevent easy cleaning.

11. SPECIAL SPECIFICATIONS (TESTS)

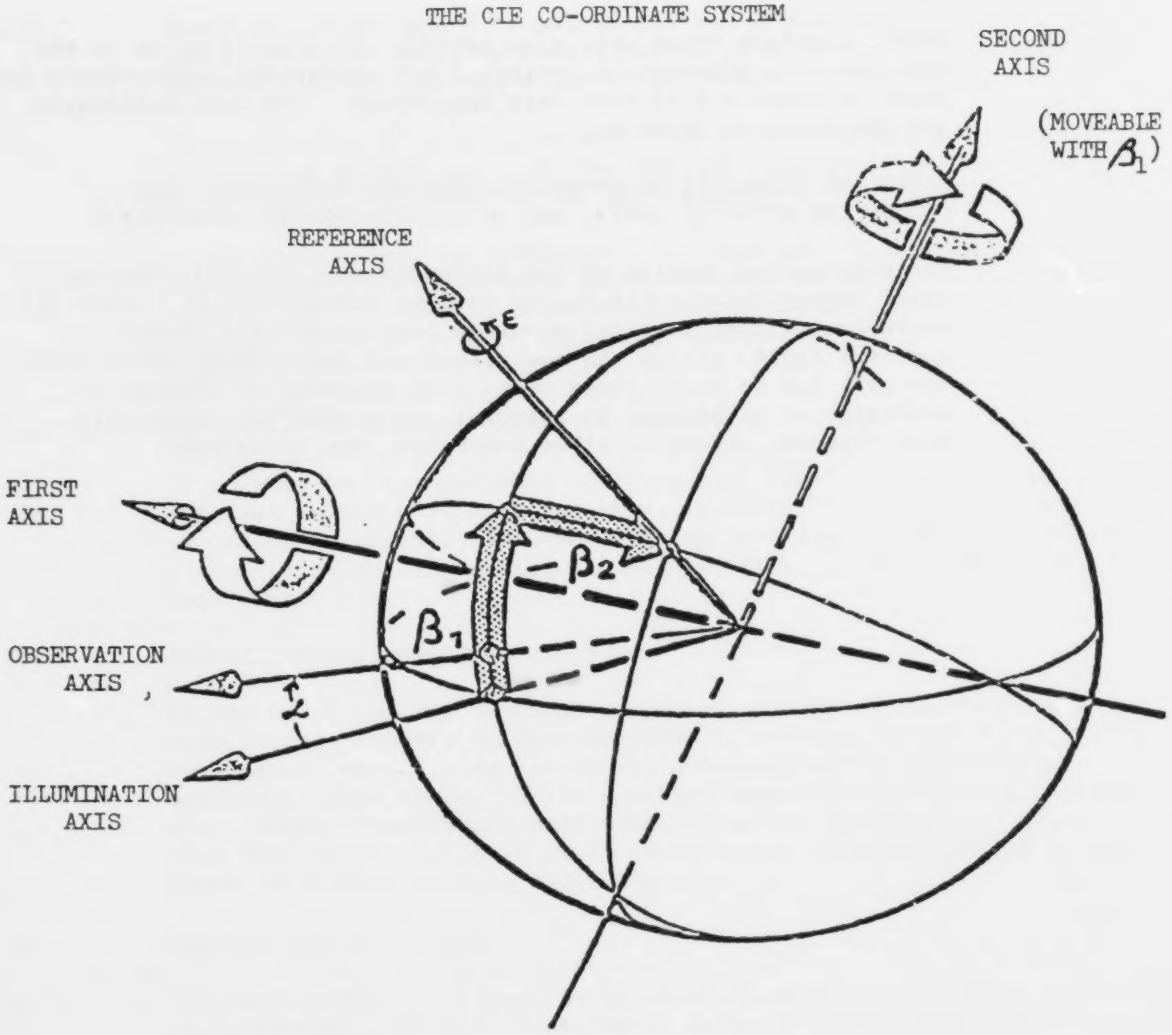
11.1 Retroreflective tyres must also satisfy the conditions as to the colorimetric, photometric, physical and mechanical requirements set forth in annexes 5 to 8 to this Regulation. The test procedures are described in annex 4.

12. NAMES AND ADDRESSES OF TECHNICAL SERVICES RESPONSIBLE FOR CONDUCTING APPROVAL TESTS, AND OF ADMINISTRATIVE DEPARTMENTS

The Contracting Parties to the Agreement applying this Regulation shall communicate to the United Nations Secretariat the names and addresses of the technical services responsible for conducting approval tests, and of the administrative departments which grant approval and to which forms certifying approval or refusal or extension or withdrawal of approval, or production definitely discontinued, issued in other countries, are to be sent.

Annex 1

THE CIE CO-ORDINATE SYSTEM



The CIE angular system for specifying and measuring retroreflectors. The first axis is perpendicular to the plane containing the observation axis and the illumination axis. The second axis is perpendicular both to the first axis and to the reference axis. All axes, angles, and directions of rotation are shown positive.

Notes: (a) The principal fixed axis is the Illumination Axis.

(b) The First Axis is fixed perpendicular to the plane containing the Observation and Illumination axis.

(c) The Reference Axis is fixed in the retroreflector and moveable with β_1 and β_2.

Annex 2

(Maximum format: A4 (210 x 297 mm))

COMMUNICATION

issued by: Name of administration
.....
.....
.....

concerning: 2/ APPROVAL GRANTED
APPROVAL EXTENDED
APPROVAL REFUSED
APPROVAL WITHDRAWN
PRODUCTION DEFINITELY DISCONTINUED

of a type of retroreflective tyre pursuant to Regulation No. 88

Approval No. ... Extension No. ...

---

1. Trade name or mark of the retroreflective tyre: .....
2. Retroreflective tyre type: .....
3. Manufacturer's name and address: .....
.....
4. If applicable, name and address of manufacturer's representative: .....
.....
5. Submitted for approval on: .....

1/ Distinguishing number of the country which has granted/extended/refused/withdrawn approval (see approval provisions in the Regulation).

2/ Strike out what does not apply.

6. Technical service responsible for conducting approval tests: .....
.....

7. Date of test report: .....

8. Number of test report: .....

9. Remarks: .....
.....

10. Vehicles to which the device is intended to be fitted (if applicable):
.....

11. Position and nature of the marking: .....

12. Approval granted/extended/refused/withdrawn 2/ .....

13. Reason(s) for extension (if applicable): .....

14. Place: .....

15. Date: .....

16. Signature: .....

17. The list of documents deposited at the administrative service which has granted approval is annexed to this communication.

2/ Strike out what does not apply.

Annex 3

EXAMPLE OF THE ARRANGEMENT OF THE APPROVAL MARK

a = 5 mm min.

88R - 002439

The above approval mark affixed to a retroreflective tyre shows that the type of retroreflective tyre concerned has been approved in the Netherlands (E 4) pursuant to Regulation No. 88 under the approval number 002439. The first two digits of the approval number indicate that the approval was granted in accordance with the requirements of Regulation No. 88 in its original form.

Note: The approval number must be placed close to the circle and either above or below the "E" or to the left or right of that letter. The digits of the approval number must be on the same side of the "E" and face the same direction. The use of Roman numerals as approval numbers should be avoided so as to prevent any confusion with other symbols.

Annex 4

TEST PROCEDURES

1. The application shall submit for approval five samples of reflective tyres, two of them being mounted on a complete wheel.

2. All samples shall be subjected to the heat resistance test of annex 8 to this Regulation, prior to the tests prescribed in annexes 5, 6 and 7.

3. After verification of the general specifications one tyre shall be subject to the colorimetric and photometric tests of annex 5 and annex 6.

4. The remaining tyres shall be subject to the physical and environmental tests as given in annex 7. For clause 4 of annex 7 the retroreflective material on each tyre shall be inspected visually. For clause 5 of annex 7 the retroreflective material on each tyre shall be tested against the photometric requirements of annex 6, table 2 for $\alpha = 20'$ and $\beta_1 = 5°$. The colour shall be checked visually as in annex 5.

5. For the tests of clauses 1 and 2 of annex 7 a portion of a tyre shall be used instead of a complete tyre.

Annex 5

COLORIMETRIC SPECIFICATIONS

1. The colour of the retroreflective annulus when illuminated by CIE Standard Illuminant A and viewed at an observation angle of 20' and an entrance angle of 5° shall fall with the boundaries on the 1931 CIE Chromaticity diagram specified in table 1.

Table 1

Chromaticity limits for retroreflective tyres

Point	1	2	3	4	5
x	0.380	0.509	0.618	0.440	0.380
y	0.408	0.490	0.382	0.382	0.337

2. Either a spectrophotometric method or a colorimeter may be used. A colorimeter shall be calibrated with a standard source or a reference surface having spectral characteristics closely related to that of the test sample.

3. A visual comparison test may be used to check compliance of the colour following the environment tests of annex 7, clauses 4 and 5 and annex 8.

Annex 6

PHOTOMETRIC SPECIFICATIONS

1. The values of the Coefficient of Luminous Intensity in millicandelas per lux (mcd/lux) shall not be less than those specified in table 2. The measurement shall be made on both sides of the tyre.

Table 2

Minimum Coefficient of Luminous Intensity R, in mcd/lux

	Entrance Angle β_1 (β_2 = 0)			
Observation Angle α	5°	20°	40°	50°
20′	16D	14D	4.7D	1.5D
1°30′	1.1D	1.0D	0.65D	0.2D

Where D is the inner diameter of the retroreflective annulus in cm. In the case where D is less than 42 cm the minimum coefficient of luminous intensity for each observation and entrance angle shall be equal to the value for D = 42 cm.

2.1 The tyre shall be mounted on a wheel and inflated to the maximum pressure recommended by the manufacturer.

2.2 The recommendations given in CIE Publication 54, Retroreflection Definition and Measurement, 1982 shall be followed for making the photometric measurements.

2.3 The preferred technique is to measure a complete tyre at a test distance of 15 m. This will involve a light source which provides a uniformly illuminated area of sufficient size to cover the diameter of the tyre.

2.4 An alternative method is to make measurements on a small angular sector of the tyre and to record the average luminous intensity of the retroreflective annulus by spinning the wheel at an appropriate speed to provide a steady reading from the photometric equipment. This method requires a smaller illuminated area and reduces the problem of screening stray light. It may also allow a reduction in the test distance.

2.5 The reference axis for all photometric measurements shall be the axis of the wheel. In case of a procedure according to paragraph 2.4 of this annex, the reference axis shall be translated parallel to itself such that it passes through the piece of the tyre to be measured.

2.6 The annular sector of the tyre, or portion of the tyre, at the photometer ahead shall not exceed 2°.

2.7 The angular sector of the light source and of the photometer head at the tyre shall not exceed 10'.

3. The ratio between the highest and the lowest R value when measured on an annular piece of the tyre consisting of an annular section of 30°, at an observation angle of 20', and an entrance angle of 5°, shall not exceed 3:1, for any position around the annulus.

4.1 Each retroreflective annulus when illuminated by the headlight of a vehicle shall give the visual impression of a circle or, at an angle, an ellipse, at entrance angles up to 30°.

4.2 The tyre shall be deemed to comply if the ratio between the lowest and the highest mean R value measured at an observation angle of 20' and an entrance angle of 30°, does not exceed 1:6.

The test is performed by placing a mask with an opening corresponding to a sector of 30° in front of the wheel.

The mean R value is obtained by rotating the wheel in the required position behind the mask at an appropriate speed, which is sufficient to ensure a steady reading from the photometric equipment, or by calculating the mean value of 12 sequential measurements of consecutive annular pieces of the tyre of 30° each.

The mask will be rotated (in steps) in front of the wheel such that the highest and lowest mean R values will be found.

Annex 7

RESISTANCE TO EXTERNAL AGENTS

1. Adhesion

The retroreflective material shall adhere to the tyre in such a way that, when conditioned and tested as described, a greater force than that specified shall be required to remove it from the substrate, or the material shall break when an attempt is made to remove it.

Condition the test sample for 30 min at a temperature of 50 ± 5° C and then for 30 min at 23 ± 5° C.

With a sharp knife, separate a strip of the retroreflective material from the tyre.

Apply a tensile force of 1 N per mm of width of the strip in a direction normal to the strip to attempt to separate it from the substrate.

2. Impact Resistance

When tested by the following method the retroreflective material shall show no cracking or separation from the tyre outside a radius of one quarter of the width of the material from the point of impact.

Condition the test sample for 1 h at -20 ± 5° C. Immediately after removal from the cold storage, place the sample on a solid support base and subject the retroreflective area to an impact from a 25 mm diameter solid steel ball dropped from a height of 2 m.

3. Resistance to Fuel

Lightly rub the retroreflective area of the test sample with a cotton cloth soaked in a test fuel composed of 70% n-heptane and 30% toluol (by volume).

After 5 min clean the retroreflective area by washing in a detergent solution and rinse in clean water.

4. Resistance to Lubricating Oil

Using the same tyre as for clause 3, lightly rub the retroreflective area of the test sample with a cotton cloth soaked in a detergent lubricating oil. After 5 min wipe the area clean with a mild aliphatic solvent such as heptane and follow by washing with a neutral detergent and rinsing in clean water.

After allowing the tyre to dry, the retroreflective material shall not show any visible change which would reduce its effective performance. The colour shall be checked visually as in annex 5.

5. Water Test

Immerse the test sample for 1 min in water at a temperature of 23 ± 5° C. Thirty seconds after removal measure the coefficient of luminous intensity at α = 20′ and β_1 = 5° C. The value shall not be less than 50% of the minimum value in table 2 of annex 6. The colour shall be checked visually as in annex 5.

Annex 8

RESISTANCE TO HEAT

When tested by the following method, there shall be no cracking, peeling or blistering of the retroreflective material that would affect the performance for the intended use:

Subject a test sample to the following conditions in sequence:

(a) Twenty-four consecutive hours at a temperature of 65 ± 5° C with a relative humidity of 10 ± 5%.

(b) At least one hour at a temperature of 23 ± 5° C and 50 ± 10% relative humidity.

(c) Fifteen consecutive hours at a temperature of -20 ± 5° C.